PATENT
Attorney Docket No. 401495/Sakai

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
KUROIWA et al.

Application No.	Unassigned	Art Unit:	Unassigned
Filed:	December 21, 2001	Examiner:	Unassigned
For:	SERIES REGULATOR		

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D. C. 20231

Dear Sir:

Prior to the examination of the above-identified patent application, please enter the following amendments and consider the following remarks.

IN THE SPECIFICATION:

Replace the paragraph beginning at page 1, line 13, with:

Fig. 5 is a circuit diagram showing a basic structure of a conventional series regulator. As shown in Fig. 5, a power transistor 503 is connected in series between an input terminal 501 to which a non-stabilized voltage Vin output from an external starting voltage source is applied and an output terminal 502 to which a stabilized voltage Vout is output. Input ends (emitters) of transistors E1, E2 and E3 that constitute a bias current circuit are connected to a line that connects the input terminal 501 and an input end (emitter) of the power transistor 503.

Replace the paragraph beginning at page 2, line 7, with:

A series circuit of resistors R1 and R2 is provided between a line that connects an output end (collector) of the power transistor 503 and an output terminal 502 and the ground. A control end of the resistors R1 and R2 is connected to a positive-phase input end of the amplifier 506. An output end of the amplifier 506 is connected to a control end (base) of the power transistor 503.

Replace the paragraph beginning at page 3, line 4, with:

As a result, the amplifier 506 changes the internal resistance of the power transistor 503 based on the result of a comparison between the magnitude of the reference voltage and the magnitude of the divided voltage, and outputs a stable constant output voltage Vout from the output terminal 502. As explained above, according to the conventional series regulator, the reference voltage circuit 505 and the amplifier 506 operate based on the bias current supplied from the input side.

IN THE CLAIMS

Replace the existing claims with:

1. (Amended) A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal;

a voltage dividing circuit for generating a divided voltage from the output voltage of the power transistor;

an output voltage detecting circuit including

a first transistor having a control terminal to which is applied a conversion voltage corresponding to the bias current that the first bias current circuit supplies to the reference voltage circuit; and

a second transistor having a control terminal to which is applied the divided voltage, wherein the second transistor is turned on and the first transistor is turned off when the divided voltage has reached the conversion voltage;

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit in response to on-operation of the second transistor, based on the output voltage of the power transistor; and

a bias switching circuit for stopping bias-current supply by the first bias current circuit in response to starting of operation of the second bias current circuit.

2. (Amended) The series regulator according to claim 1, wherein

the first bias current circuit and the second bias current circuit supply a bias current to the amplifier, and switching of a bias-current supply to the amplifier is linked to switching of a bias-current supply to the reference voltage circuit.

3. (Amended) A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a voltage dividing circuit for generating a divided voltage from the output voltage of the power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal, the first bias current circuit supplying a bias current to the reference voltage circuit during a period while a first transistor, having a control terminal to which a conversion voltage corresponding to the bias current is applied, is in an on-operation; and

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the power transistor, the second bias current circuit for supplying a bias current to the reference voltage circuit during a period while a second transistor, having a control terminal to which the divided voltage is applied, is in an on-operation, wherein the second transistor is turned on when the divided voltage has reached the conversion voltage, and the first transistor is subsequently turned off.

4. (Amended) The series regulator according to claim 3, wherein

the first bias current circuit and the second bias current circuit supply a bias current to the amplifier, and switching of a bias-current supply to the amplifier is linked to switching of a bias-current supply to the reference voltage circuit.

5. (Amended) A series regulator comprising:

a first power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and a first output terminal;

a first amplifier for changing an internal resistance of the first power transistor based on a comparison between an output voltage of the first power transistor and a reference voltage, and outputting a stabilized constant voltage to the first output terminal;

a second power transistor connected in series between the input terminal and a second output terminal;

a second amplifier for changing an internal resistance of the second power transistor based on a comparison between an output voltage of the second power transistor and the reference voltage, and outputting a stabilized constant voltage to the second output terminal;

a first voltage dividing circuit for generating a first divided voltage from the output voltage of the first power transistor, and a second voltage dividing circuit for generating a second divided voltage, different from the first divided voltage, from the output voltage of the second power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal, the first bias current circuit supplying a bias current to the

reference voltage circuit during a period while a first transistor, having a control terminal to which a conversion voltage corresponding to the bias current is applied, is in an on-operation;

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the first power transistor, the second bias current circuit supplying a bias current to the reference voltage circuit during a period while a second transistor, having a control terminal to which the first divided voltage is applied, is in an on-operation; and

a third bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the second power transistor, the third bias current circuit supplying a bias current to the reference voltage circuit during a period while a third transistor, having a control terminal to which the second divided voltage is applied, is in an on-operation, wherein only a corresponding one of the second transistor and the third transistor is turned on when the one of the first divided voltage and the second divided voltage having a higher value has first reached the conversion voltage, and the first transistor is subsequently turned off.

6. (Amended) The series regulator according to claim 5, further comprising a circuit for switching on/off operations between the second transistor and the third transistor to stop operation of the one of the first power transistor and the second power transistor that is generating an output voltage on which basis the bias current is being supplied.

7. (Amended) The series regulator according to claim 5, wherein

the first bias current circuit, the second bias current circuit, and the third bias current circuit supply a bias current to the amplifiers, and switching of a bias-current supply to the amplifier is linked with switching of a bias-current supply to the reference voltage circuit.

REMARKS

The foregoing amendments are made to correct minor translational errors and to meet United States requirements as to form. No new matter is added.

Respectfully submitted,

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AMENDMENTS TO SPECIFICATION, CLAIMS, AND ABSTRACT MADE VIA PRELIMINARY AMENDMENT

Amendments to the paragraph beginning at page 1, line 13:

Fig. 5 is a circuit diagram showing a basic structure of a conventional series regulator. As shown in Fig. 5, a power transistor 503 is connected in series between an input terminal 501 to which a non-stabilized voltage Vin output from an external starting voltage source is applied and an output terminal 502 to which a stabilized voltage Vout is output. Input ends (emitters) of transistors E1, E2 and E3 that constitute a bias current circuit are connected to a line that connects ~~between~~ the input terminal 501 and an input end (emitter) of the power transistor 503.

Amendments to the paragraph beginning at page 2, line 7:

A series circuit of resistors R1 and R2 is provided between a line that connects ~~between~~ an output end (collector) of the power transistor 503 and an output terminal 502 and the ground. A control end of the resistors R1 and R2 is connected to a positive-phase input end of the amplifier 506. An output end of the amplifier 506 is connected to a control end (base) of the power transistor 503.

Amendments to the paragraph beginning at page 3, line 4:

As a result, the amplifier 506 changes the internal resistance of the power transistor 503 based on ~~a~~ the result of a comparison between the ~~size~~ magnitude of the reference voltage and the ~~size~~ magnitude of the divided voltage, and ~~controls to output~~ outputs a stable constant output voltage Vout from the output terminal 502. As explained above, according to the conventional series regulator, the reference voltage circuit 505 and the amplifier 506 operate based on the bias current ~~all~~ supplied from the input side.

Amendments to the existing claims:

1. (Amended) A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on ~~a result of~~ a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on ~~a~~ the non-stabilized voltage applied to the input terminal;

a ~~resistance~~ voltage dividing circuit for generating a divided voltage ~~of a predetermined value~~ from ~~an~~ the output voltage of the power transistor;

an output voltage detecting circuit including

a first transistor ~~to~~ having a control ~~end of~~ terminal to which ~~there~~ is applied a conversion voltage ~~of a~~ corresponding to the bias current that the first bias current circuit supplies to the reference voltage circuit; and

a second transistor ~~to~~ having a control ~~end of~~ terminal to which ~~there~~ is applied the divided voltage, wherein ~~the output voltage detecting circuit having a differential structure such that~~ the second transistor is turned on and the first transistor is turned off when the divided voltage has reached ~~a value of~~ the conversion voltage;

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit in response to ~~the~~ on-operation of the second transistor, based on ~~an~~ the output voltage of the power transistor; and

a bias switching circuit for stopping ~~a~~ bias-current supply ~~operation of~~ by the first bias current circuit in response to ~~a~~ starting of ~~the~~ operation of the second bias current circuit.

2. (Amended) The series regulator according to claim 1, wherein

the first bias current circuit and the second bias current circuit ~~are structured to~~ supply a bias current to the amplifier, and ~~a~~

switching of a bias-current supply to the amplifier is ~~executed~~ linked ~~with a~~ to switching of a bias-current supply to the reference voltage circuit.

3. (Amended) A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on ~~a result of~~ a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a ~~resistance~~ voltage dividing circuit for generating a divided voltage ~~of a predetermined value~~ from ~~an~~ the output voltage of the power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on ~~a~~ the non-stabilized voltage applied to the input terminal, the first bias current circuit ~~for~~ supplying a bias current to the reference voltage circuit during a period while a first transistor ~~to~~, having a control ~~end of~~ terminal to which a conversion voltage ~~of~~ corresponding to the bias current is applied, is in an on-operation; and

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on ~~an~~ the output voltage of the power transistor, the second bias current circuit for supplying a bias current to the reference voltage circuit during a period while a second transistor ~~to~~, having a control ~~end of~~ terminal to which the divided voltage is applied, is in an on-operation, wherein ~~the first bias current circuit and~~

~~the second bias current circuit are differentially structured such that~~ the second transistor is turned on when the divided voltage has reached ~~a value of~~ the conversion voltage, and the first transistor is subsequently turned off ~~following this~~.

4. (Amended) The series regulator according to claim 3, wherein

the first bias current circuit and the second bias current circuit ~~are structured to~~ supply a bias current to the amplifier, and ~~a~~

switching of a bias-current supply to the amplifier is ~~executed~~ linked ~~with a~~ to switching of a bias-current supply to the reference voltage circuit.

5. (Amended) A series regulator comprising:

a first power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and a first output terminal;

a first amplifier for changing an internal resistance of the first power transistor based on a ~~result of a~~ comparison between an output voltage of the first power transistor and a reference voltage, and outputting a stabilized constant voltage to the first output terminal;

a second power transistor connected in series between the input terminal and a second output terminal;

a second amplifier for changing an internal resistance of the second power transistor based on a ~~result of a~~ comparison between an output voltage of the second power transistor and the reference voltage, and outputting a stabilized constant voltage to the second output terminal;

a first ~~resistance~~ voltage dividing circuit for generating a first divided voltage ~~of a predetermined value~~ from ~~an~~ the output voltage of the first power transistor, and a second ~~resistance~~ voltage dividing circuit for generating a second divided voltage ~~of a predetermined value~~, different from the first divided voltage, from ~~an~~ the output voltage of the second power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on ~~a~~ the non-stabilized voltage applied to the input terminal, the first bias current circuit ~~for~~ supplying a bias current to the reference voltage circuit during a period while a first transistor ~~to~~, having a control

~~end of~~ terminal to which a conversion voltage ~~of~~ corresponding to the bias current is applied, is in an on-operation;

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on ~~an~~ the output voltage of the first power transistor, the second bias current circuit ~~for~~ supplying a bias current to the reference voltage circuit during a period while a second transistor ~~to~~, having a control ~~end of~~ terminal to which the first divided voltage is applied, is in an on-operation; and

a third bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on ~~an~~ the output voltage of the second power transistor, the third bias current circuit ~~for~~ supplying a bias current to the reference voltage circuit during a period while a third transistor ~~to~~, having a control ~~end of~~ terminal to which the second divided voltage is applied, is in an on-operation, wherein ~~the first bias current circuit, the second bias current circuit, and the third bias current circuit are differentially structured such that~~ only a corresponding one of the second transistor and the third transistor is turned on when ~~either~~ the one of the first divided voltage ~~or~~ and the second divided voltage having a higher value has first reached ~~a value of~~ the conversion voltage, and the first transistor is subsequently turned off ~~following this~~.

6. (Amended) The series regulator according to claim 5, further comprising a circuit for switching ~~the~~ on/off operations between the second transistor and the third transistor to stop ~~the~~ operation of the one of the first power transistor ~~or~~ and the second power transistor that is generating an output voltage on which basis ~~a~~ the bias current is being supplied.

7. (Amended) The series regulator according to claim 5, wherein

the first bias current circuit, the second bias current circuit, and the third bias current circuit ~~are structured to~~ supply a bias current to the amplifiers, and ~~a~~

switching of a bias-current supply to the amplifier is ~~executed~~ linked with ~~a~~ switching of a bias-current supply to the reference voltage circuit.

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PENDING CLAIMS AFTER ENTRY OF PRELIMINARY AMENDMENT

1. A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal;

a voltage dividing circuit for generating a divided voltage from the output voltage of the power transistor;

an output voltage detecting circuit including

a first transistor having a control terminal to which is applied a conversion voltage corresponding to the bias current that the first bias current circuit supplies to the reference voltage circuit; and

a second transistor having a control terminal to which is applied the divided voltage, wherein the second transistor is turned on and the first transistor is turned off when the divided voltage has reached the conversion voltage;

a second bias current circuit for generating a bias current to be supplied to the

reference voltage circuit in response to on-operation of the second transistor, based on the output voltage of the power transistor; and

a bias switching circuit for stopping bias-current supply by the first bias current circuit in response to starting of operation of the second bias current circuit.

2. The series regulator according to claim 1, wherein

the first bias current circuit and the second bias current circuit supply a bias current to the amplifier, and switching of a bias-current supply to the amplifier is linked to switching of a bias-current supply to the reference voltage circuit.

3. A series regulator comprising:

a power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and an output terminal;

an amplifier for changing an internal resistance of the power transistor based on a comparison between an output voltage of the power transistor and a reference voltage, and outputting a stabilized constant voltage to the output terminal;

a voltage dividing circuit for generating a divided voltage from the output voltage of the power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal, the first bias current circuit supplying a bias current to the reference voltage circuit during a period while a first transistor, having a control terminal to which a conversion voltage corresponding to the bias current is applied, is in an on-operation; and

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the power transistor, the second bias current circuit for supplying a bias current to the reference voltage circuit during a period while a second transistor, having a control terminal to which the divided voltage is applied, is in an on-operation, wherein the second transistor is turned on when the divided voltage has reached the conversion voltage, and the first transistor is subsequently turned off.

4. The series regulator according to claim 3, wherein

the first bias current circuit and the second bias current circuit supply a bias current to the amplifier, and switching of a bias-current supply to the amplifier is linked to switching of a bias-current supply to the reference voltage circuit.

5. A series regulator comprising:

a first power transistor connected in series between an input terminal to which a non-stabilized voltage is applied and a first output terminal;

a first amplifier for changing an internal resistance of the first power transistor based on a comparison between an output voltage of the first power transistor and a reference voltage, and outputting a stabilized constant voltage to the first output terminal;

a second power transistor connected in series between the input terminal and a second output terminal;

a second amplifier for changing an internal resistance of the second power transistor based on a comparison between an output voltage of the second power transistor and the reference voltage, and outputting a stabilized constant voltage to the second output terminal;

a first voltage dividing circuit for generating a first divided voltage from the output voltage of the first power transistor, and a second voltage dividing circuit for generating a second divided voltage, different from the first divided voltage, from the output voltage of the second power transistor;

a first bias current circuit for generating a bias current to be supplied to a reference voltage circuit that generates the reference voltage, based on the non-stabilized voltage applied to the input terminal, the first bias current circuit supplying a bias current to the reference voltage circuit during a period while a first transistor, having a control terminal to which a conversion voltage corresponding to the bias current is applied, is in an on-operation;

a second bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the first power transistor, the second bias current circuit supplying a bias current to the reference voltage circuit during a period while a second transistor, having a control terminal to which the first divided voltage is applied, is in an on-operation; and

a third bias current circuit for generating a bias current to be supplied to the reference voltage circuit, based on the output voltage of the second power transistor, the third bias current circuit supplying a bias current to the reference voltage circuit during a period while a third transistor, having a control terminal to which the second divided voltage is applied, is in an on-operation, wherein only a corresponding one of the second transistor and the third transistor is turned on when the one of the first divided voltage and the second divided voltage having a higher value has first reached the conversion voltage, and the first transistor is subsequently turned off.

6. The series regulator according to claim 5, further comprising a circuit for switching on/off operations between the second transistor and the third transistor to stop operation of the one of the first power transistor and the second power transistor that is generating an output voltage on which basis the bias current is being supplied.

7. The series regulator according to claim 5, wherein

the first bias current circuit, the second bias current circuit, and the third bias current circuit supply a bias current to the amplifiers, and switching of a bias-current supply to the amplifier is linked with switching of a bias-current supply to the reference voltage circuit.